The number of CPEs transmitting on any frequency is equal to the hub capacity to receive the circuits. The hub density and average CPE spacing was calculated for the TI system for use in interference calculations. Other systems may be correlated to the results by applying a factor for the difference between system densities. For example, for the CellularVision system the average spacing for the large footprint (row 11, column E of Table B2) would be 43 km, resulting in an additional margin for the C/I ratio. This density also assumes worst case of 100% suitability for LMDS. In actuality, not all area or populous is suited for LMDS due to coverage, competition from other services or for economic reasons.

NRMC/84 (Rev. 1)
Sept. 23, 1994

VIEWS OF NRMC MEMBERS SUPPORTING MOTOROLA-SUITE 12/CVNY RULE PROPOSAL IN THE FORM OF THEIR VERSION OF SECTION VI TO REPORT OF WORKING GROUP 2

The following represents the views of those NRMC members who wish to go on record at this time in support of the Motorola-Suite 12/CVNY rule proposal (the "Joint Parties"). These views are provided in the form of their version of Section VI to the Report of Working Group 2. The Joint Parties are identified on the attached signature page .

CONCLUSIONS AND REGULATORY PROPOSALS

6.1 CONCLUSIONS

A. Overview of Conclusions on Sharing Cases Analyzed

(1) LMDS into Non-GSO MSS Feeder Link Satellite Receivers

For transmissions from LMDS hub stations the major mitigation technique is to limit the transmited power at or above the horizon. Using the quick look analysis program, the maximum spectral power density per unit area of hubs was developed for the three climate zones such that the uplink interference would not exceed -13 dB Io/No with the "Quick Look Spread Sheet" (-11.5 dB with Fortran simulation). The hub side lobe patterns are a composite developed from the three LMDS proponents table of characteristics. The spreadsheets developing the limits in Tables 6-1 and 6-2 are detailed in Attachment 1 hereto. The EIRP spectral area density is calculated as follows:

$$10\log\left(\frac{1}{A}\sum_{i=1}^{N} P_i G_i\right) dBW / MHz - km^2$$

where:
N = number of co-frequency hubs in service area
A = service area in km^2

P_i = spectral power density into antenna of i th hub (dBW/MHz)
Gi = gain of i th hub antenna at zero degree elevation angle (dBi)

TABLE 6-1
SPECTRAL AREA DENSITY LIMITS VS. CLIMATE ZONE

Climate Zone	EIRP Spectral Density (Clear Air) (dBWi/MHz-km^2)*
1	-23
2	-25
3,4,5	-26

* See Section 21.1007(c)(i) for the population density of the BTA

TABLE 6-2
SPECTRAL AREA DENSITY VS. ELEVATION ANGLE

Elevation Angle (a)	Relative EIRP Density (dBW/MHz-km^2)
$0° \leq a \leq 4.0°$	EIRP(a) = EIRP(0°) + 20 log((sinπx)(1/πx)) where x = (a + 1)/7.5°
$4.0° \leq a \leq 7.7°$	EIRP(a) = EIRP(0°) - 3.85a + 7.7
$a > 7.7°$	EIRP(a) = EIRP(0°) - 22

To protect the satellite against an occasional high level burst of the type that could occur with a backbone station, LMDS backbone transmitting stations should be limited to an EIRP no greater than 23 dBW/MHz. With this limit, the Iridium System carrys an additional 3 dB link margin in order to absorb the occasional main beam to main beam hit that might unlock the satellite demodulator such as might occur with a backbone transmission.

The LMDS operators should also design their go/return channel plan to avoid subscriber transmitter operations in the band designated for non-GSO MSS feeder link bands. Non-GSO MSS operators should restrict operation of their feederlinks to the 29.1 to 29.5 GHz band.

(2) Non-GSO MSS Feeder Link Earth Stations into LMDS Receivers

Clearly, it takes significant LMDS antenna discrimination combined with geographic separation to avoid interference into LMDS

receivers from the side lobes of an earth station tracking a Non-GSO satellite to elevation angles as low as 5°. Motorola and Suite 12, therefore, recommended the establishment of zones surrounding fixed coordinates within selected cities where the LMDS operator would not be able to ask for protection from transmissions within the feeder link portion of the band. It was recommended that this region be within a 75 nautical mile radius of the preselected coordinates. Motorola expects to be able to install up to three diversity earth stations within that region. It is further contemplated that coordination between LMDS and MSS operators outside that 75 nm radius would be required. Successful coordination is more likely to be achieved for earth station sites which are some distance within the 75 nm unless terrain shielding and/or site shielding prove to be applicable.

B. Annotation of Proposed Rules

Rule 1:

This rule addresses the issue of potential interference from MSS gateway and satellite control stations into LMDS receivers (NRMC/8, Case 2) by establishing certain requirements for the locations and operations of MSS gateway and satellite control stations, and for LMDS operations in the 29.1-29.5 GHz band.

As an initial matter, it should be noted that the 29.1-29.5 GHz band is the only band segment that would be subject to these requirements because Motorola Satellite Communications, Inc. is the only non-geostationary MSS system applicant which has proposed to operate feeder links in the 27.5-29.5 GHz band, and the particular portion of the band it has proposed to use is 29.1-29.3 GHz. The rules also cover the 29.3-29.5 GHz portion of the band in order to provide for potential feeder link operations by other non-GSO MSS systems in the same processing group as the IRIDIUM System should those other systems, which have proposed to use other spectrum for feeder link operations, be required to utilize Ka-band spectrum for their feeder link operations. It is recognized that in CC Docket No. 92-166, the Commission identified the 29.5-30.0 GHz band, in addition to the 27.5-29.5 GHz band, as a band that could potentially be used to help satisfy the feeder link requirements of those non-GSO MSS applicants who have requested feeder link spectrum below 15 GHz. It is recognized, however, that the 29.3-30.0 GHz band may

not provide sufficient spectrum to accommodate all three of the non-GSO MSS applicants who fall into this category, particularly since TRW has requested a portion of the 29.5-30.0 GHz band for its feeder links. To the extent that the 29.3-29.5 GHz band is not used by the other four non-GSO MSS operators, it would be available as potential expansion spectrum for IRIDIUM System gateway operations or for feeder link operations associated with future MSS systems.

Rule 1 contains two fundamental provisions: (1) the establishment of zones around certain protected non-GSO MSS feeder link earth station complexes within which LMDS receive stations must accept any interference caused to them by such earth stations and can claim no protection from such earth stations; and (2) restrictions on the number and geographic location of non-GSO MSS feeder link earth stations in order to minimize the impact of these protection zones on the deployment and operations of LMDS systems. This rule reflects the fact, unlike the case of potential LMDS interference into non-GSO MSS satellite receivers (NRMC/8, Case 6), potential interference from non-GSO MSS systems into LMDS receivers (Case 2) is largely a function of the location of the earth stations. The rule also reflects the likelihood that LMDS systems will be deployed in the band prior to the time that non-GSO MSS systems are deployed. This gives rise to the need on the part of non-GSO MSS operators for assurances that LMDS systems will not be able to claim protection from interfering earth stations on the basis of first-in-time interference rights.

The rule attempts to strike a balance between the needs of non-GSO MSS operators for assurances that their systems cannot be required to cease or restrict operations in response to interference complaints, and the need of LMDS providers for assurances that any encumbrances on their use of the spectrum resulting from the operations of feeder link earth stations will be minimized. For potential LMDS operators, it is important that any possible encumbrances on the spectrum be known prior to the issuance of LMDS licenses, presumably by auction. In this connection, the rule would place limits on: (1) the number of non-GSO MSS operators that could use this band for feeder links; (2) the number of feeder link earth station sites that any one non-GSO MSS operator could establish; (3) the amount of spectrum that any one non-GSO MSS earth station licensee could use at a given location; (4) the number of markets within given ranges of MSAs which could be selected as

potential feeder link earth station complexes; and (5) the number of non-GSO MSS operators that could establish feeder link earth stations within the top 100 MSAs.

With respect to the location of non-GSO MSS feeder link stations, the proposed rule contemplates that only Motorola would be allowed to select feeder link earth station sites within the top 100 MSAs because, as noted above, Motorola is the only non-GSO MSS applicant which has proposed to use the 27.5-29.5 GHz band for its feeder links and because the other non-GSO MSS applicants have indicated during the negotiated rulemaking that if they were required to use the 27.5-29.5 GHz band, their earth station complexes would likely be located outside of major metropolitan areas. Other non-GSO MSS operators would have the option of utilizing either the locations identified by Motorola, or selecting locations that are consistent with the general provision of proposed Section 21.1002(c)(6)(i) (i.e., anywhere that is outside of 75 miles from the boundaries of the top 100 MSAS), provided that they are utilizing different frequencies from Motorola. These restrictions are necessary to minimize the encumbrance, or even the appearance of any encumbrance, on LMDS operations in major markets. As for the Motorola sites, it is important to recognize that the number of feeder link earth station complexes allotted to a given MSA range is not an arbitrary number, but reflects a number that Motorola and Suite 12/CVNY find mutually agreeable and prudent in terms of maximizing use of the 28 GHz spectrum by separate, viable pro-consumer services. At any point after it selects its eight feeder link earth station complex locations, Motorola would have the ability to substitute a different location consistent with proposed Section 21.1002(c)(6)(i).

An important assumption underlying this rule is that Motorola would be the only non-GSO MSS operator licensed to use the 29.1-29.3 GHz band. Motorola is of the view that it will not be possible for the IRIDIUM System to share feeder link spectrum on a co-frequency basis with other non-GSO MSS systems. However, even if co-frequency sharing between Motorola and other non-GSO MSS operators were feasible, it would still be undesirable because it would preclude the option of other non-GSO MSS operators being able to locate their gateway and satellite control stations within the same top 100 MSAs selected by Motorola due to the separation distances that would likely be required.

Establishing a rule which explicitly accommodates Motorola's gateway and satellite control station needs is justified from a public interest standpoint for several reasons. First, it is important to recognize that one of the fundamental underpinnings of the co-frequency sharing agreement reflected in NRMC/49 is that the amount of spectrum subject to a potential encumbrance from the standpoint of LMDS operators is limited to 400 MHz. If this amount were increased, LMDS operators would likely not find this co-frequency sharing arrangement acceptable. At the same time, if Motorola were to face the prospect of having to compete against other non-GSO MSS operators for access to the 29.1-29.3 GHz band, then it could not agree to a sharing plan that limits the amount of spectrum available to non-GSO MSS operators in the 27.5-29.5 GHz band to only 400 MHz.

Second, it is reasonable for Motorola to be the only non-GSO MSS operator licensed to use the 29.1-29.3 GHz band because it is the only such operator to have planned for use of this band. As noted above, of the current group of five applicants who filed non-GSO MSS above 1 GHz applications about four years ago, Motorola is the only one who proposed to operate feeder links in the 27.5-29.5 GHz band. As explained in NRMC/32, the 29.1-29.3 GHz portion of that band was selected primarily on the basis of global spectrum occupancy in order to facilitate coordination around the world and, in fact, the ITU coordination of this spectrum for the IRIDIUM System has been in progress for over two years. NRMC/32 also explains that in designing the Application Specific Integrated Circuit to be used in IRIDIUM System feeder link equipment, the bandwidth was limited to this 200 MHz segment because wideband circuits to cover the full 27.5-29.5 GHz band would not meet spacecraft design requirements. Thus, any change in the IRIDIUM System frequency plan at this juncture would cause substantial delays in the ITU coordination process and require significant redesign efforts, with corresponding delays in the initiation of service to the public.

Finally, establishing a rule which gives Motorola the flexibility to select feeder link earth station sites within the top 100 MSAs is reasonable because Motorola is the only non-GSO MSS operator which has identified an operational requirement to locate feeder link earth stations within such markets and because limiting the number of major markets subject to a potential encumbrance is a major factor in making the proposed rules acceptable to LMDS interests.

In order to provide potential LMDS operators with certainty regarding the possible encumbrances on the spectrum in major markets prior to the commencement of spectrum auctions for LMDS licenses, Motorola would be required under Section 21.1002(c)(5) to identify the eight MSAs within which it might locate gateway or satellite control stations at least 45 days prior to the commencement of LMDS auctions. (The reason Section 21.1002(c)(5) specifically lists the Phoenix and Honolulu MSAs is that Motorola has already determined that a satellite control stations will be located in Chandler, AZ, and in Waimea on the island of Oahu.) It is anticipated that the FCC would make this information on Motorola's site selections available by public notice. Similar information might be provided with respect to sites selected by other non-GSO MSS operators, pursuant to the general provision of Section 21.1002(c)(6)(i).

The information provided by Motorola and possibly other non-GSO MSS operators prior to the LMDS license auctions would be a set of geographic coordinates in a given MSA or, if known at that time, the coordinates of the individual earth stations. In most cases, such earth station-specific coordinates are not expected to be available at that time due to unknown variables such as site acquisition and zoning or the fact that a particular MSA is intended as the site of a future gateway based on system growth. In fact, the need for such flexibility in siting those earth stations in part forms the basis for the 75 nautical mile "feeder link earth station complex protection zone" specified in Section 21.1002(c)(4). Within this zone, LMDS receive stations operating on frequencies in the 29.1-29.5 GHz band would have to accept any interference caused to them by feeder link earth stations and would not be able to claim protection from such earth stations. Outside of this 75 nautical mile zone, LMDS and feeder link earth station operators would be required to engage in a coordination.

The provision that non-GSO MSS feeder link earth stations may not be located within 75 nautical miles of the boundaries of the top 100 MSAs is designed to eliminate potential interference to LMDS receive stations in those larger MSAs.

Section 21.1002(c)(7) also attempts to minimize the impact on LMDS operations by requiring all non-GSO MSS earth station licensees to provide the affected LMDS licensees with copies of their channel plans. This would provide the LMDS operator with information on the

specific frequencies within the 29.1-29.5 GHz band that are subject to potential interference and thereby enable them to maximize their use of the spectrum by arranging their channel plans so that those frequencies are used for transmissions which need not be of the highest quality.

Rule 2:

This rule reflects the fact that proposed rule 21.1004 on the content and form of LMDS applications, as set forth in the first NPRM in this proceeding (NRMC/2), does not provide for a technical exhibit. Among other things, it is anticipated that the LMDS applicant would be supplying its antenna patterns as part of this requirement. To the extent that it is necessary for non-GSO MSS operators to provide technical information pursuant to any proposed rules which are also incorporated into Part 25, they would be subject to a parallel requirement.

Rule 3:

This rule must be read in conjunction with the note to Rule 6 on hub transmitter EIRP spectral area density limits. By establishing a build-out requirement of 25%, the rules will have the flexibility needed to provide for lower hub densities in less densely populated BTAs. Without this provision, an unreconcilable conflict may arise between the limits in rules 6 and 7 and a requirement to serve more than 25 percent of the population. This conclusion has been reached based on detailed examination of population density patterns, allowable numbers of LMDS hubs per service area as constrained by rules 6 and 7 and the expected coverage of a single LMDS hub in the various climate regions in the U.S. Further, under a spectrum auction licensing scheme, a 25 percent build-out requirement should be suffcient to address concerns about the warehousing of spectrum.

Rule 4:

This rule establishes an EIRP limit on point-to-point LMDS backbone links. The lower EIRP provided for in this rule is necessary because the maximum allowable EIRP in existing rule section 21.107(b) (i.e., 55 dBW) would cause unacceptable interference to IRIDIUM satellite receivers. As explained in NRMC/36, sharing between MSS feeder links and LMDS backbones is feasible with a reasonable EIRP because backbone terminals are expected to be relatively few in number.

Rule 5:

This rule prohibits subscriber units from transmitting in the 29.1 to 29.5 GHz frequency band and is based on the conclusion that sharing is not possible for subscriber links transmitting in the same frequency band in which a non-GSO MSS satellite receives signals from the feeder link earth station. The rationale for this conclusion is as follows:

1. Subscriber units are typically high power and have high antenna gains. In some cases, even only one subscriber unit pointing toward the satellite would cause unacceptable interference. See Attachment I to WG2 Report (NRMC-82).

2. Subscriber units typically point to the horizon or point upwards where the hub antennas typically point to the horizon or downward. Pointing upwards makes sharing less possible whereas pointing downward aids in sharing. See Attachment I to WG2 Report (NRMC-82).

3. There are many more subscribers than there are hubs. There could be several hundred subscribers for each hub. Each of these subscribers is a potential source of interference if pointed toward the satellite.

4. The number of hubs will generally be well defined by the LMDS system operator, allowing interference calculations to the satellite to be made. The number of subscriber transmitters and their antenna pointing is basically unknown as it is a variable. This means that the interference to the satellite cannot be calculated. This was the conclusion of the technical analysis in section 4 of the Working Group 2 Final Report.

5. A rule concerning the transmission from subscriber units in the satellite frequency band would be unenforcable. As a practical matter, the ultimate responsibility for detection of harmful interference to the satellite would rest with the satellite operator. It would be impossible to track down the source of interference from potentially millions of subscriber transmitters in the antenna footprint of the satellite.

The prohibition on subscriber units from transmitting in the designated feeder link portion of the band should not be considered a band segmentation scheme. Rather, it is a channel plan. All of the LMDS systems operate in a full duplex mode where hub and subscriber transmissions are on different frequencies. This rule allows up to 60% of band B to be used for subscriber-to-hub links (28.5 - 29.1 GHz) and 100 % of the band (28.5 - 29.5 GHz) to be used for hub-to-subscriber links. No LMDS system has demonstrated a need for more than 60% of the band to be used for subscriber transmissions.

Rule 6:

The limits established in this rule for power spectral density radiated toward the horizon on a per-unit-area basis are intended to allow LMDS hub emissions at or below the level which would result in unacceptable interference into the IRIDIUM satellite receiver. The summation procedure used to implement the rule allows the LMDS operator some flexibility in using a mix of antennas and transmitter power levels to serve subscribers. The three different limit values (for climate regions 1, 2 and 3/4/5) are due to the different water vapor absorption levels expected on the path between potentially interfering LMDS hubs and the satellite receiver in the three different climate regions. Where absorption is the highest (region 1), higher LMDS power levels can be accepted.

The Note below Table 1 in Rule 6 is intended to allow the trading of credits for LMDS power density per unit area between service areas to allow a higher likelihood that LMDS operators can reach their service goals than would be the case if the limits in Table 1 are strictly imposed in every service area (BTA). The mechanics of implementation for the procedure suggested in the note have not been resolved. While said mechanics are expected to be cumbersome, the flexibility afforded by the adjustments between service areas is an imperative if LMDS is to be commercially viable with the limits imposed in Table 1.

Rule 7:

This rule is similar in intent to Rule 6, where Rule 6 addresses LMDS power radiated toward the horizon, and Rule 7 addresses LMDS power radiated at elevation angles from the horizon to zenith. The "shape" of the EIRP mask in Rule 7 is intended to match a physically realizable antenna. The rule is structured as a power density mask, rather than as an antenna mask, to give LMDS operators "credit" for squinting antennas down or

employing antennas with better sidelobe suppression than assumed in the construction of the rule.

Rule 8:

This rule helps facilitate co-frequency sharing by reducing the average power levels received by non-GSO MSS satellite receivers. In the analyses that led to the construction of Rules 3, 6 and 7, it was apparent that without the LMDS employment of alternate polarizations and frequency interleaving, or some alternate method of aggregate interference reduction, one or both of the following would occur: (1) interference at the satellite receiver at levels exceeding the maximum level acceptable to Motorola; and/or (2) significantly reduced service to LMDS subscribers either by limiting service to a smaller number of hubs than necessary to serve given areas in a commercially viable fashion or by limiting coverage areas of individual hubs.

These effects may arise because the limits imposed in Rules 6 and 7 simultaneously place the interference into the satellite at the maximum level acceptable to Motorola and limit the number of LMDS hubs deployable in a given service area to a number which may constrain the availability of LMDS services to an undesirably low level. Since the first problem is unattractive to satellite service providers and the second is unattractive to LMDS service providers, both parties benefit by an LMDS operators' use of the techniques set forth in Rule 9 in that the potential problems are more likely avoided. Finally, since there may be other techniques unknown to those who drafted the rules that may accomplish the same effect, subsection (c) allows the employment of other techniques in place of alternate polarizations and frequency interleaving as long as those techniques accomplish the same effect.

Rule 9:

This rule inserts appropriate definitions into Part 21 of the Commission's rules.

6.2 RECOMMENDATIONS

The Joint Parties recognize that three of the five current applicants for non-GSO MSS system licenses have requested spectrum below 15 GHz for their feeder links and that one has sought spectrum at 29.5-30.0 GHz. These applicants were identified by the Commission as interested parties in the instant proceeding. The Joint Parties also

recognize that the Commission will determine, in other proceedings, whether the applicants who requested spectrum below 15 GHz will be required to use spectrum in the 27.5-29.5 GHz band for their feeder links.

Because of the public interest benefit in implementing both LMDS and MSS, Working Group 2 sought to accommodate sharing of frequencies by LMDS and non-GSO MSS feeder links. However, in order to ensure the operation of both services with a minimum of interference, the Joint Parties recommend that the Commission identify spectrum outside the 27.5-29.5 GHz band, and preferably in the frequency ranges requested by the applicants, for use for feeder links by Constellation Communications, Inc., Loral QUALCOMM Partnership, L.P., Mobile Communications Holdings, Inc. and TRW. It is noted, however, that if the 29.1-29.5 GHz band is combined with the 29.5-30.0 GHz band, it should be possible to accommodate at least two non-GSO MSS operators at Ka-band.

6.3 RULES

1. Amend proposed rule section 21.1002 by adding new subsection (c) as follows:

21.1002 Frequencies

(c) Special requirements for operations in the band 29.1-29.5 GHz.

(1) Non-geostationary mobile satellite service (non-GSO MSS) operators who filed applications by the cut-off date of June 3, 1991 established by Public Notice dated April 1, 1991 (Report No. DS-1068) shall use the 29.1-29.5 GHz band for Earth-to-space transmissions from feeder link earth station complexes to the extent these operators need or are required to use the 27.5-29.5 GHz band. For purposes of this subsection, a "feeder link earth station complex" may include up to three (3) earth stations, with each earth station having up to four (4) antennas, located within a radius of 75 nautical miles of a given set of geographic coordinates provided by a non-GSO MSS operator pursuant to subsections (c)(5) or (c)(6)(i).

(2) Each non-GSO MSS operator may concurrently operate a maximum of eight (8) feeder link earth station complexes in the contiguous United States, Alaska, and Hawaii.

(3) Except for certain occasional satellite control operations, no non-GSO MSS earth station operator may have an occupied bandwidth of more than 200 MHz at any single feeder link earth station complex.

(4)(i) LMDS receive stations operating on frequencies in the 29.1-29.5 GHz band within a radius of 75 nautical miles of the geographic coordinates provided by a non-GSO MSS operator pursuant to subsections (c)(5) or (c)(6)(i) (the "feeder link earth station complex protection zone") shall accept any interference caused to them by such earth station complexes and shall claim no protection from such earth station complexes.

(ii) LMDS licensees operating on frequencies in the 29.1-29.5 GHz band outside a feeder link earth station complex protection zone shall cooperate fully and make reasonable efforts to resolve technical problems with the non-GSO MSS operator to the extent that transmissions from the non-GSO MSS operator's feeder link earth station complex interfere with an LMDS receive station.

(5) At least 45 days prior to the commencement of LMDS auctions, the non-GSO MSS applicant within the processing group defined in subsection (c)(1) who proposed, in its initial application, to utilize a portion of the 27.5-29.5 GHz band for its feeder link earth stations shall specify a set of geographic coordinates for its feeder link earth station complexes in accordance with the following requirements: no feeder link earth station complex may be located in the top eight (8) metropolitan statistical areas ("MSAs"), ranked by population, as defined by the Office of Management and Budget as of June 1993, using estimated populations as of December 1992; two (2) complexes may be located in MSAs 9 through 25, one of which must be Phoenix, AZ (for a complex at Chandler, AZ); one (1) complex may be located in MSAs 26 to 50; three (3) complexes may be located in MSAs 51 to 100, one of which must be Honolulu, Hawaii (for a complex at Waimea); and the two (2) remaining complexes must be located at least 75 nautical miles from the borders of the 100 largest MSAs or in any MSA not included in the 100 largest MSAs. Any location allotted for one range of MSAs may be taken from an MSA below that range.

(Note: This rule can be amended so as to list the eight sets of coordinates after they are identified.)

(6)(i) Any non-GSO MSS operator may at any time specify sets of geographic coordinates for feeder link earth station complexes with each earth station contained therein to be located at least 75 nautical miles from the borders of the 100 largest MSAs.

(ii) For purposes of subsection (c)(7)(i), non-GSO MSS feeder link earth station complexes shall be entitled to accommodation only if the affected non-GSO MSS operator preapplies to the Commission for a feeder link earth station complex or certifies to the Commission within sixty days of receiving a copy of an LMDS application that it intends to file an application for a feeder link earth station complex within six months of the date of receipt of the LMDS application.

(iii) If said non-GSO MSS operator's application is filed later than six months after certification to the Commission, the LMDS and non-GSO MSS entities shall still cooperate fully and make reasonable efforts to resolve technical problems, but the LMDS licensee shall not be obligated to re-engineer its proposal or make changes to its system.

(7) LMDS licensees or applicants proposing to operate hub stations on frequencies in the 29.1-29.5 GHz band at locations outside of the 100 largest MSAs or within a distance of 150 nautical miles from a set of geographic coordinates specified under subsection (c)(5) or (c)(6)(i) shall serve copies of their applications on all non-GSO MSS applicants, permittees or licensees meeting the criteria specified in subsection (c)(1). Non-GSO MSS licensees or applicants shall serve copies of their feeder link earth station applications on any LMDS applicant or licensee within a distance of 150 nautical miles from the geographic coordinates that it specified under subsection (c)(5) or (c)(6)(i). Any necessary coordination shall commence upon notification by the party receiving an application to the party who filed the application. The results of any such coordination shall be reported to the Commission within sixty days. The non-GSO MSS earth station licensee shall also provide all such LMDS licensees with a copy of its channel plan.

(Note: The foregoing rule should also be implemented by making the appropriate modifications to Part 25 of the Commission's Rules.)

2. Amend proposed rule section 21.1004 by adding new subsection (b)(5)(x) as follows:

21.1004 Content and Form of Applications.

(b)(5)(x). Exhibit X: Demonstration of Compliance with Technical Rules

3. Amend proposed rule section 21.1007(c)(i) by substituting the following language:

21.1007(c)(i) The boundaries of the GSA must include 25% of the population of the BTA.

4. Add new rule section 21.1018 as follows:

21.1018 LMDS Single Station EIRP Limit. Point-to-point stations in the 29.1 -29.5 GHz band for the LMDS backbone between LMDS hubs shall be limited to a maximum allowable EIRP per carrier of 23 dBWi/MHz in any one megahertz in clear air, and may exceed this limit by employment of adaptive power control in cases where link propagation attenuation exceeds the clear air value and only to the extent that the link is impaired.

(**Note:** The foregoing rule should also be implemented by making the appropriate modification or deletion to Section 21.107(b)).

5. Add new rule section 21.1019 as follows:

21.1019. LMDS Subscriber Transmissions. LMDS licensees shall not operate transmitters from subscriber locations in the 29.1 - 29.5 GHz band.

6. Add new rule section 21.1020 as follows:

21.1020 Hub Transmitter EIRP Spectral Area Density Limit. LMDS applicants shall demonstrate that, under clear air operating conditions, the maximum aggregate of LMDS transmitting hub stations in a Basic Trading Area in the 29.1-29.5 GHz band will not transmit a co-frequency hub-to-subscriber EIRP spectral area density in any azimuthal direction in excess of X dBWi/(MHz-km^2) when averaged over any 4.375 MHz band, where X is defined in Table 1. Individual hub stations may exceed their clear air EIRPs by employment of adaptive power control in cases where link

propagation attenuation exceeds the clear air value and only to the extent that the link is impaired.

The EIRP aggregate spectral area density is calculated as follows:

$$10\log\left(\frac{1}{A}\sum_{i=1}^{N} P_i G_i\right) dBW / MHz - km^2$$

where:
N = number of co-frequency hubs in BTA
A = Area of BTA in km^2
P_i = spectral power density into antenna of i-th hub (in W/MHz)
Gi = gain of i-th hub antenna at zero degree elevation angle
Each P_i and Gi are in the same 1 MHz

The climate zones in Table I are defined for different geographic locations within the US as shown in Appendix 28 of the ITU Radio Regulations and Section 25.254 of the Commission's Rules.

Table 1

Climate Zone	EIRP Spectral Density (Clear Air) (dBWi/MHz-km^2)*
1	-23
2	-25
3,4,5	-26

* See Section 21.1007(c)(i) for the population density of the BTA

(**Note:** LMDS system licensees in two or more BTAs may individually or collectively deviate from the spectral area density computed above by averaging the power over any 200 km by 400 km area, provided that the aggregate interference to the satellite receiver is no greater than if the spectral area density were as specified in Table 1. A showing to the Commission comparing both methods of computation is required and copies shall be served on any affected non-GSO MSS providers.)

7. Add new rule section 21.1021 as follows:

21.1021 Hub Transmitter EIRP Spectral Area Density Limit at Elevation Angles Above the Horizon. LMDS applicants shall

demonstrate that, under clear air operating conditions, the maximum aggregate of LMDS transmitting hub stations in a Basic Trading Area in the 29.1 - 29.5 GHz band will not transmit a co-frequency hub-to-subscriber EIRP spectral area density in any azimuthal direction in excess of X dBWi/(MHz-km^2) when averaged over any 4.375 MHz band, where X is defined in table 2. Individual hub stations may exceed their clear air EIRPs by employment of adaptive power control in cases where link propagation attenuation exceeds the clear air value and only to the extent that the link is impaired.

The EIRP aggregate spectral area density is calculated as follows:

$$10\log\left(\frac{1}{A}\sum_{i=1}^{N} EIRP(a_i)\right) dBW / MHz - km^2$$

where:
N = number of co-frequency hubs in BTA
A = Area of BTA in km^2
EIRP(a_i) = equivalent isotropic radiated spectral power density of the i-th hub (in W/MHz) at elevation angle *a*

Table 2

Elevation Angle (a)	Relative EIRP Density (dBW/MHz-km^2)
$0° \le a \le 4.0°$	EIRP(a) = EIRP(0°) + 20 log(sinπx)(1/πx) where x = (a + 1)/7.5°
$4.0° < a \le 7.7°$	EIRP(a) = EIRP(0°) - 3.85a + 7.7
$a > 7.7°$	EIRP(a) = EIRP(0°) - 22

where *a* is the angle in degrees of elevation above horizon. EIRP(0°) is the hub EIRP area density at the horizon used in Section 21.1020. The nominal antenna pattern will be used for elevation angles between 0° and 8°, and average levels will be used for angles beyond 8°, where average levels will be calculated by sampling the antenna patterns in each 1° interval between 8° and 90°, dividing by 83.

(**Note:** See note to 6 above.)

8. Add ~~new~~ rule section 21.1022 as follows:

21.1023 Power Reduction Techniques. LMDS hub transmitters shall employ methods to reduce average power levels received by non-GSO MSS satellite receivers, to the extent necessary to comply with Sections 21.1020 and 21.1021, by employing the methods set forth below:

(a) Alternate Polarizations. LMDS hub transmitters in the LMDS service area may employ both vertical and horizontal linear polarizations such that 50 percent (plus or minus 10 percent) of the hub transmitters shall employ vertical polarization and 50 percent (plus or minus 10 percent) shall employ horizontal polarization.

(b) Frequency Interleaving. LMDS hub transmitters in the LMDS service area may employ frequency interleaving such that 50 percent (plus or minus 10 percent) of the hub transmitters shall employ channel center frequencies which are different by one-half the channel bandwidth of the other 50 percent (plus or minus 10 percent) of the hub transmitters.

(c) Alternative Methods. As alternatives to (a) and (b) above, LMDS operators may employ such other methods as may be shown to achieve equivalent reductions in average power density received by non-GSO MSS satellite receivers.

21.1024 Additional Coordination Obligation. The two LMDS operators in each LMDS service area shall coordinate their polarizations and channelizations so as to minimize interference to one another.

9. Modify Rule Section 21.2 by inserting new definitions in the appropriate alphabetical order as follows:

Local Multipoint Distribution Service Hub Station. A fixed point-to-multipoint radio station in a Local Multipoint Service System that provides one-way or two-way communication with Local Multipoint Distribution Service Subscriber Stations.

Local Multipoint Distribution Service System. A fixed point-to-multipoint radio system consisting of Local Multipoint Distribution Service Hub Stations and their associated Local Multipoint Distribution Service Subscriber Stations.

Local Multipoint Distribution Service Subscriber Station. Any one of the fixed microwave radio stations located at users' premises, lying within the coverage area of a Local Multipoint Distribution Service Hub Station, capable of receiving one-way communications from or providing two-way communications with the Local Multipoint Distribution Service Hub Station.

Local Multipoint Distribution Service Backbone Link. A point-to-point radio service link in a Local Multipoint Distribution Service System that is used to interconnect Local Multipoint Distribution Service Hub Stations with each other or with the public switched telephone network.

ATTACHMENT 1

Suite 12 Hubs into Iridium

6378.0	earth radius (km)				
7158.0	earth radius & sat. altitude (km)		PARAMETERS FOR A 0°		0.0
			ELEV. ANGLE TO SATELLITE:		63.0
1221.0	footprint length @ 10° elevation (km)				27.0
200.0	footprint width @ 10° elevation (km)				63.0
					3249.3
111.3	1° of circumference (km)				
10.0	**hub spacing (km) Zone 1**	6.2	**hub spacing miles**		
100.0	hub area (km^2)				
22263.4	"swath" area (km^2)				
222.6	no. of hubs in one "swath"				
111.3	no. of hubs co-frequency/swath				
type	**Hub Transmitting station**				
29.0	frequency of operation (GHz)				
20.0	TWTA Saturated Output (dBW)				
-7.0	TWTA Backoff (dBW)				
-16.9	Band split 49 channels (dB)				
-3.9	Hub Xmtr Power/Channel (dBW)				
-1.0	Ant Feed Losses (dB)				
-4.9	Channel power to Antenna (dBW)				
-72.6	18 MHz Power Bandwidth (dBW-Hz)				
5.6	Peaking Factor (dB)				
-71.9	Xmtr spectral density/Hub (dBW/Hz)				
-22.9	**Peak Spectral Area Density (dBWI/MHz-km^2)**		Io/No (dB)	-13.3	
	"-71.9+60+12+10log(#co frequency channels/22263)"		Interference Margin	0.3	

Suite 12 Hubs into Iridium

mid swath elevation angle (°)	0.5	1.5	2.6	3.7	4.9	6.1	7.4	8.8	10.2	11.8	13.4
nadir angle (°)	63.0	63.0	62.9	62.8	62.6	62.4	62.1	61.7	61.3	60.7	60.1
interior angle (°)	26.5	25.5	24.5	23.5	22.5	21.5	20.5	19.5	18.5	17.5	16.5
latitude angle (°)	63.5	64.5	65.5	66.5	67.5	68.5	69.5	70.5	71.5	72.5	73.5
slant range (km)	3193.7	3082.4	2971.1	2860.0	2749.0	2638.2	2527.6	2417.4	2307.7	2198.4	2089.8
hub xmit power(dBW/Hz)	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9
hub xmit gain (dBi)	10.0	8.1	6.0	2.0	-1.0	-7.0	-10.0	-10.0	-10.0	-10.0	-10.0
path loss (dB)	-191.8	-191.5	-191.2	-190.8	-190.5	-190.1	-189.8	-189.4	-189.0	-188.5	-188.1
atmosph loss (dB) Zone 1	-13.5	-8.2	-5.6	-4.2	-3.2	-2.7	-2.2	-1.9	-1.6	-1.4	-1.3
antenna polarization loss(dB)	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
satellite receive gain (dBi)	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5
no. of hubs in each swath (dB)	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
received power density (dBW/Hz)	-221.2	-217.5	-216.6	-218.9	-220.6	-225.7	-227.8	-227.2	-226.5	-225.8	-225.3
received power density (W/Hz)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
percent total interference/swath	9.2	21.6	26.1	15.5	10.6	3.2	2.0	2.3	2.7	3.2	3.6
total power received (W/Hz)	0.0										
total power received (dBW/Hz)	-210.8										
satellite noise floor (dBW/Hz)	-197.5										

Suite 12 Hubs into Iridium

6378.0	earth radius (km)				
7158.0	earth radius & sat. altitude (km)		PARAMETERS FOR A 0°		0.0
			ELEV. ANGLE TO SATELLITE:		63.0
1221.0	footprint length @ 10° elevation (km)				27.0
200.0	footprint width @ 10° elevation (km)				63.0
					3249.3
111.3	1° of circumference (km)				
12.5	hub spacing (km) Zone 2	7.8	Hub spacing miles		
156.3	hub area (km^2)				
22263.4	"swath" area (km^2)				
142.5	no. of hubs in one "swath"				
71.2	no. of hubs co-frequency/swath				
type	Hub Transmitting station				
29.0	frequency of operation (GHz)				
20.0	TWTA Saturated Output (dBW)				
-7.0	TWTA Backoff (dBW)				
-16.9	Band split 49 channels (dB)				
-3.9	Hub Xmtr Power/Channel (dBW)				
-1.0	Ant Feed Losses (dB)				
-4.9	Channel power to Antenna (dBW)				
-72.6	18 MHz Power Bandwidth (dBW-Hz)				
5.6	Peaking Factor (dB)				
-71.9	Xmtr spectral density/Hub (dBW/Hz)				
\					
-24.8	Peak Spectral Area Density (dBWi/MHz-km^2)		Io/No (dB)	-12.8	
	"-71.9+60+12+10log(#cofreq hubs/22263)"		Interference Margin	-0.2	

Suite 12 Hubs into Iridium

mid swath elevation angle (°)	0.5	1.5	2.6	3.7	4.9	6.1	7.4	8.8	10.2	11.8	13.4
nadir angle (°)	63.0	63.0	62.9	62.8	62.6	62.4	62.1	61.7	61.3	60.7	60.1
interior angle (°)	26.5	25.5	24.5	23.5	22.5	21.5	20.5	19.5	18.5	17.5	16.5
latitude angle (°)	63.5	64.5	65.5	66.5	67.5	68.5	69.5	70.5	71.5	72.5	73.5
slant range (km)	3193.7	3082.4	2971.1	2860.0	2749.0	2638.2	2527.6	2417.4	2307.7	2198.4	2089.8
hub xmit power(dBW/Hz)	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9	-71.9
hub xmit gain (dBi)	10.0	8.1	6.0	2.0	-1.0	-7.0	-10.0	-10.0	-10.0	-10.0	-10.0
path loss (dB)	-191.8	-191.5	-191.2	-190.8	-190.5	-190.1	-189.8	-189.4	-189.0	-188.5	-188.1
atmosph loss (dB) Zone 2	-8.0	-5.0	-3.5	-2.6	-2.1	-1.7	-1.4	-1.2	-1.1	-0.9	-0.8
antenna polarization loss(dB)	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
satellite receive gain (dBi)	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5
no. of hubs in each swath (dB)	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
received power density (dBW/Hz)	-217.6	-216.2	-216.5	-219.3	-221.4	-226.7	-229.0	-228.4	-227.9	-227.3	-226.7
received power density (W/Hz)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
percent total interference/swath	18.6	25.7	24.1	12.7	7.7	2.3	1.4	1.6	1.7	2.0	2.3
total power received (W/Hz)	0.0										
total power received (dBW/Hz)	-210.3										
satellite noise floor (dBW/Hz)	-197.5										

Suite 12 Hubs into Iridium

6378.0	earth radius (km)				
7158.0	earth radius & sat. altitude (km)		PARAMETERS FOR A 0°		0.0
			ELEV. ANGLE TO SATELLITE:		63.0
1221.0	footprint length @ 10° elevation (km)				27.0
200.0	footprint width @ 10° elevation (km)				63.0
					3249.3
111.3	1° of circumference (km)				
15.0	hub spacing (km) zones 3-5	9.3	Hub spacing miles		
225.0	hub area (km^2)				
22263.4	"swath" area (km^2)				
98.9	no. of hubs in one "swath"				
49.5	no. of hubs co-frequency/swath				
type	Hub Transmitting station				
29.0	frequency of operation (GHz)				
20.0	TWTA Saturated Output (dBW)				
-7.0	TWTA Backoff (dBW)				
-16.9	Band split 49 channels (dB)				
-3.9	Hub Xmtr Power/Channel (dBW)				
-1.0	Ant Feed Losses (dB)				
-4.9	Channel power to Antenna (dBW)				
-72.6	18 MHz Power Bandwidth (dBW-Hz)				
5.6	Peaking Factor (dB)				
-71.9	Xmtr spectral density/Hub (dBW/Hz)				
\					
-26.4	Peak Spectral Area Density (dBWi/MHz-km^2)		Io/No (dB)	-13.0	
	"-71.9+60+12+10log(#co-frequency hubs/22263)"		Interference Margin	0.0	